

Errata and editorial changes to *Semiconductor Detector Systems*

- p. viii Acknowledgements: replace DE-AC03-76SF00098 by DE-AC02-05CH11231
- p. 3 third to last line: delete (right) after Fig. 1.4
- p. 6 Fig. 1.7 caption: delete space in “co nversion”
- p. 7 insert comma after  $\sigma_1 = \sigma_2 = \sigma$
- sentence following eqn 1.2: replace “determined” by “limited”
- p. 9, 10 lighten shaded areas
- p. 12 Section 1.7, par. 2, line 5: replace  $\gamma$ -rays by gamma-rays
- p. 13 line 2: insert “see” in (Sze 1981)
- p. 17 Fig. 1.16: lighten shaded area
- p. 19 par. 2, line 4: replace  $\gamma$ -ray by gamma-ray
- p. 20 par. 2, line 2: insert comma after “In reality, however”
- p. 21 Fig. 1.18: lighten shaded area
- p. 22 Fig. 1.19: lighten shaded area
- Caption, line 3: ... through the intermediate (replace “by”)
- p. 23 par. 2, line 2: The energy deposited by minimum ionizing particles fluctuates along the track ... (replace “Minimum ionizing particles do not deposit energy uniformly ... “)
- p. 25 Fig. 1.21: lighten shaded area
- p. 25 par. 1: match tense to SLD detector used: The sensitive depth was ..., Electronic noise was ..., minimum ionizing particles yielded ..., The readout rate was 5 MHz and four readout amplifiers were used ...
- p. 26 par. 1, 2<sup>nd</sup> to last line: exploited (rather than exploted)
- p. 28 par 2, line 7: delete space in 1 000.
- p. 29 Section 1.9

par 1, line 2: the same basic ... (insert “same”)  
 par 1, line 3: replace “are the same” by “apply to all”.  
 par. 2, line 2: measurement, or timing (insert comma)  
 par. 3, line 2: delete comma after “for example”.

p. 33 line 9: insert comma after “constant”.

p. 34 line 12: ... and the noise minimum (insert “the”)

3<sup>rd</sup> to last line: insert (Figure 4.29) after ... to longer shaping times.

p. 35 line following top eqn: For a given amplifier (*i.e.*  $e_n$ ), noise is improved...  
 (insert “For a given amplifier ( $e_n$ )”)

p. 38 Fig. 1.32 figure caption: add (Photographs courtesy of M. Garcia-Sciveres and C. Haber)

p. 39 next to last sentence of 1<sup>st</sup> par: bypass instead of bypass capacitors

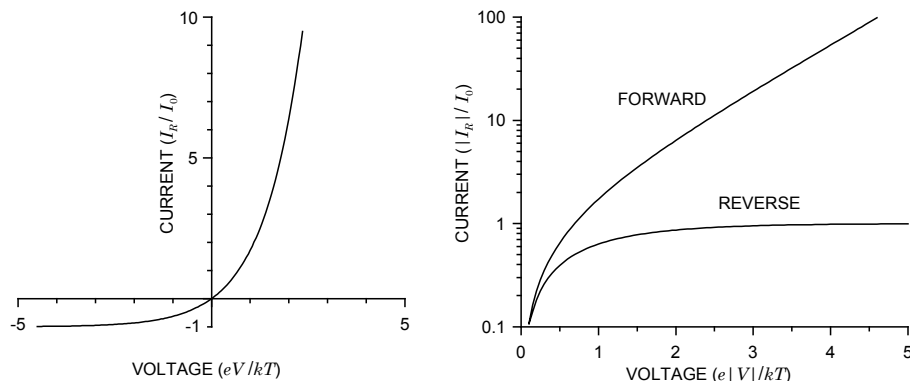
p. 53 eqn 2.6:  $\sigma_i$  should be  $\sigma_{ion}$ .

p. 53 In the last and next-to-last line move  $E_i$ :  
 Overall, the number  $N_Q$  of charge pairs formed is the total deposited energy  $E_0$  divided by the average energy deposition  $E_i$  required to produce a charge pair.

p. 57 add words and in equation change  $E_i$  to  $E_b$ :  
 Thus, the Coulomb force that binds the electron to the donor atom is reduced by the dielectric constant  $\epsilon$  of the medium ( $\epsilon=11.9$  in Si), so the binding energy

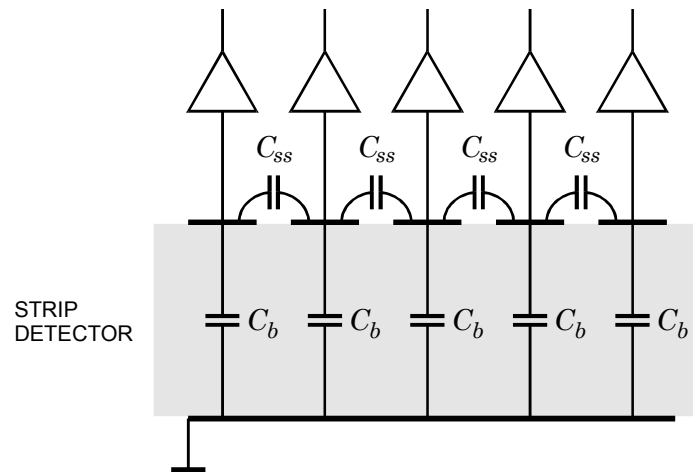
$$E_b(lattice) \approx \frac{E_b(atom)}{\epsilon^2}.$$

p. 62 in Fig. 2.21 add labels FORWARD and REVERSE.



- p. 65 sentence following eqn 2.31: insert space in “n-and p-regions”
- p. 83 line after eqn 2.88: much greater than the drift length (instead of “less”)
- p. 83 line 2 after eqn 2.90: Hecht equation (Hecht 1932) (instead of 1927)
- p. 84 modify end of par. 2: High purity GaAs has shown better results (Owens 1999). Many interesting materials are not available as single crystals of sufficient size. Furthermore, direct bandgap materials tend to be more susceptible to recombination.
- p. 85 in eqn 2.91 and the following line change  $C$  to  $C_d$ .
- p. 86 2<sup>nd</sup> par, sentence 1: for ~~a~~ more details (strike a)
- p. 87 Replace comma with period after eqn 2.95 and modify the following line:  
In silicon  $\alpha_n = 3.36 \cdot 10^6 \text{ cm}^{-1}$  and ...
- p. 90 bottom paragraph, line 3: These devices ... (plural)
- p. 91 line 2: replace signal-to-noise ratio by signal level.
- p. 93 line 4:  $V_0 = Q_s / C_d$  instead of  $V_0 = Q_s / C_{det}$   
Add at end of section before 2.9.4: This is discussed further in Chapter 3.
- p. 96 \index{amplifier!phase response|()} instead of  
\index{amplifier!phase reponse|() }
- p. 98 + 99 In figures 2.44 and 2.45 change to  $A_v$  (rather than  $A_V$ )
- p. 99 \index{amplifier!phase response|)} instead of  
\index{amplifier!phase reponse|)}  
  
line 6: stable instead of stables
- p. 101, 102 change  $C_{\{SG\}}$  to  $C_b$  and  $C_{\{SS\}}$  to  $C_{\{ss\}}$ .

Fig. 2.46: shade silicon bulk, add detector label



p. 102 References: Hecht, K (**1932**) (instead of 1927)

p. 104 in ref. Webb (1972) insert period after title.

p. 105 Fig. 3.1 caption: gamma-ray instead of gamma ray

p. 106 line 1: In many detectors (instead of For many ...)  
line 3: gamma-rays instead of gamma rays  
replace 3 000 by 3000 (3 times)

p. 107 1<sup>st</sup> paragraph of Section 3.3, lines 3 – 6:  
However, in analyzing electronic noise we need to describe the noise in terms of voltage and current spectral densities  $dv_n / \sqrt{df}$  and  $di_n / \sqrt{df}$ . In circuit design literature and data sheets these are commonly abbreviated as  $dv_n / \sqrt{df} \equiv e_n$  and  $di_n / \sqrt{df} \equiv i_n$ , so we'll follow that convention.

p. 108 first line: strike “only”

p. 110 1<sup>st</sup> sentence of Section 3.4.1: conclude with colon

sentence before eqn 3.12:

At low frequencies  $hf \ll kT$  the spectral power density

Last line:

... the noise power that can be transferred to an external device is

$P_n = kTB$ . (add is)

- p. 111, 112      in eqns 3.18 and 3.19 :  $\sqrt{df}$
- p. 113      in Fig. 3.5 caption: small space in 1 s.
- p. 116      par. 1, last sentence: signal-to-noise ratio equals one. (instead of is one)
- next-to-last paragraph line 3 and eqn 3.40: change  $\varepsilon_i$  to  $E_i$  .  
 For an ionization energy  $E_i$  the energy resolution  

$$\Delta E_n = E_i \cdot \text{ENC} .$$
- p. 121      last sentence: terminate with colon
- p. 124      end of 1<sup>st</sup> paragraph: replace “and” by “, so”  
 ... the noise voltage at the amplifier input becomes negligible  $|e_{ni}| \ll |e_{nf}|$  ,  
 so  $|e_{nf}| \approx |e_n|$  .
- p. 125      par. 2, line 2:  
 Thus, the net noise voltage at the amplifier input  $e_{ni} = e_n - |e_{nf}|$  is  
 diminished ... (replace  $|v_{nf}|$  .
- Last line on page: add “is” (... the input current to the amplifier is)
- p. 126      sentence following eqn 3.74: insert  $C$   
 Then the peak amplifier signal is inversely proportional to the *total capacitance  $C$  at the input*, ...
- p. 130      1<sup>st</sup> sentence of par. 1: backplane capacitance  $C_b$
- p. 131      sentence before eqn 3.80:  
 The additional noise injected from the backside amplifier (amplifier 1 in Figure 3.16) into a single electrode is
- p. 137      Fig. 4.4 caption: change second sentence to  
 The integration and differentiation time constants are scaled with the number of integrators ( $\tau = \tau_{n=1} / n$ ) to maintain the peaking time.
- p. 137      line 2 following eqn 4.5: ... time constants are scaled (plural)
- p. 138      par. 1 line 11: in “analysis of with” strike “of”
- line 1 of Section 4.2: replace comprise by utilizes and replace the subsequent utilize by apply.

- p. 139 3<sup>rd</sup> to last line on page: Since the measured noise level depends on the resolution bandwidth ... (rather than spectral density)
- p. 140 Use square brackets for the outer brackets in the equation.
- p. 140 Gaussian distributions spaced by their FWHM ... should be  
Gaussian distributions spaced by twice their rms value ...
- p. 141 Item 1: equation same as on previous page.  
  
item 2: ... magnitude of the output signal ... (insert “the”)
- p. 143 par 2, line 1: Steps in the analysis are: (insert colon)  
  
line 1 of Section 4.3.1: delete appear.
- p. 145 line following eqn 4.9:  $T_p \ll R_p C_d$  (instead of  $C_D$ )  
  
line 2 after eqn 4.11: The input noise current has the same effect as the detector bias current, so the analysis ... (strike “is the same” and “for”)
- p. 148 Section 4.4.1, line 3: collinearly instead of colinearly
- p. 154 line 2:  $S_1$  (rather than S1)  
line 2:  $S_2$  (rather than S2)
- p. 155 replace eqn 4.23 by  $A(f) = \text{const}$  and eqn 4.24 by  $A(f) \propto \frac{1}{f}$ .
- p. 157 Fig. 4.22: increase line widths
- p. 158 line1: ... whose choice depends ... (instead of “depend”)
- p. 168 in Table 4.1 enclose CDS parameters in parentheses.
- p. 171 line before eqn 4.58: replace period by comma  
  
Section 4.7.1, par. 2, 2<sup>nd</sup> sentence:  
... widths of the noise and time distributions ... (insert “the”)
- p. 177 2<sup>nd</sup> to last line: preamplifier instead of preamplfier
- p. 180 line before eqn 4.72: ... and 90% amplitude, so  $t_r = 2.2\tau$ .
- p. 182 next to last line: ... so the relative contribution of electrons and holes is always the same and rise time compensation is not necessary.

(replace “, so” by “and”)

- p. 185 line 2 following eqn 4.84: move (equation 4.83) to the next line, so Triggering on the leading edge of the unipolar signal, say at  $V_T = 0.1V_0$  or  $T = 0.11$ , yields a slope (equation 4.83) at the trigger point ...
- p. 188 line 2: signal-to-noise ratio (insert hyphens)
- p. 191 last line before Section 5.1.1: ... as a simple matter of “yes” or “no”... (insert of)
- p. 192 end of 1<sup>st</sup> par.: flip-flop (insert hyphen), also in caption of Fig. 5.2
- p. 192 2<sup>nd</sup> par.: replace “The probability of these marginal events may be extremely rare ...” by “These marginal events may be extremely rare ...” Swap last and next-to-last sentences.
- Fig. 5.2: D Flip-Flop (add hyphen), also in caption: flip-flops
- p. 203 Move subsection heading 5.2.2.1 to next paragraph
- p. 204 par. 2, line 3: replace bit by bin.
- p. 206 Subsection 5.2.2.3, line 4: ... memory capacitor  $C$ .
- p. 213 3<sup>rd</sup> to last line in par. 1: insert comma after hardware
- p. 214 Fig. 5.29 caption: ... “aliases” high-frequency components ... (replace “a” by “high”, insert hyphen)
- p. 215 line 6: insert “the” before “ADC”
- p. 216 ref Embree (spillover right margin)
- p. 216 ref. Zimmerman \it (missing backslash)
- p. 217 line 4: insert comma after (JFET)
- p. 220 Fig. 6.3 caption line 2: insert comma after ... one layer down
- p. 222 end of line 7: insert  $(\beta_{DC})$  after constant.

Section 6.1.1, 1<sup>st</sup> sentence of par. 2: The differential behavior, as for a small signal superimposed on the bias voltages, is the same for both *nnp* and *pnp* devices, so the basic amplifier equations apply to both types.

- p. 223 Sentence following eqn 6.7: At a given temperature the transconductance depends only... (add “At a given temperature”)
- p. 226 line 2 of next-to-last par.:  
... and the external resistances  $R_C$  and  $R$  shown in Fig. 6.7.  
(add “shown in Fig. 6.7”)
- p. 227 line 2: insert space after transistor
- p. 229 line 2 of par. 3: high-frequency (insert hyphen)
- p. 230 line 1: insert comma after ICs
- p. 232 line 4 of Subsection 6.2.1.1: insert comma after resistive
- p. 234 Fig. 6.16: more precise plot to remove ripples
- p. 235 item 1, line 2: devices (plural)
- p. 243 in first bullet replace the semicolon by “and”
- p. 245 eqn 6.50: last term should be  $Z_{i_{nG}}^2$ .
- p. 247 eqn 6.60: italicize “min” in  $Q_{n,\min}$
- p. 251 Two enumerated items at bottom of page: Begin with upper case, strike “and,” in first item, add periods at end.
- p. 253-4 duplicate text: eqns 6.79 and 6.80 and associated text redundant.  
Note that all subsequent equation numbers are decremented by 1.
- p. 258 Fig. 6.36: lower right replace subscript to  $(W/L)_N$
- p. 262 in 3<sup>rd</sup> to last line:  $f_u = f_0 / (1 + C_d / C_f)$
- p. 263 par. 4, line 2: time constants (instead of “times”)  
par. 4, line 6: all higher poles
- p. 263 eqn 6.98:  $A_{vL} = A_{v0} \frac{C_f}{C_d + C_f}$  (lower case subscript  $v$ )  
in following line:  $A_{v0}$
- p. 263 last line: conditions instead of condicions
- p. 264 par. 1, line 12: delete “is” at end of line.

- p. 265 line 2: of the rationale (add “the”)
- p. 266 Table 6.1, last sentence of caption:  
The individual contributions listed account for about 95% of the total noise.
- p. 270 inserted small spaces (\,) at 10 pF and 1 fF
- p. 271 2 000 and 1 400: delete space
- p. 277 insert comma after nuclear reactor
- p. 278 par. 2: split first sentence. ... is not easy. Nevertheless, one can apply ...
- p. 279 line 6 of Subsection 7.1.1: (NIEL, Burke 1986)
- p. 287 line 4:  $c = 1 - 3$  (turn into dash)
- p. 288 line 3 of final paragraph: delete “Anti-annealing”
- p. 289 Fig. 7.5: italicize vs in caption.
- p. 297 par 3, last line: replace “electronics” by “electrons”
- p. 298 par. 2, next-to-last line: ( $> 0.5 \mu\text{m}$  feature size)
- p. 303 next to last line: difficult (instead of dificult)
- p. 305 3<sup>rd</sup> to last line: insert comma after “For example”
- p. 307 last line: “minimize” instead of “minimized”
- p. 308 par. 1, line 12: replace differential amplifier by differential comparator
- p. 308 last par., line 2: *n*- and *p*-MOSFETs (insert hyphens)
- p. 309 in ref. Beattie (2000): environment (instead of envuronment)  
Nucl. Instr. and Meth. instead of Nucl.Instrum.Meth.
- p. 315 itemized list: insert commas at end of items and a period after the last.
- p. 315 par. 2: Move first two sentences to end of paragraph.
- p. 316 Section 8.2.1, line 10: replace “photon detectors” by “photon imagers”.

- p. 320 par. 2, line 6: dash rather than hyphen in “vertex-tracking”
- p. 321 Fig. 8.4 caption: insert comma after “increases”.
- p. 322 Par. 2, line 14: ... is “split” midway with readouts at ... (strike “and”)
- p. 323 par. 1, line 6: replace “Some sensors” by “Some other detectors ...”  
 par. 1, line 9: after “bussing” insert “used in BaBar”.  
 par. 2, line 3: HDIs (plural)
- p. 329 between eqns 8.7 and 8.8: ... sensor parameters alone, (insert comma)
- p. 335 par. 2, line 9: add ) after “Chapter 9”.
- p. 343 Section 8.6.1, line 3: insert comma after “on the other hand”.
- p. 353 par. 3, line 1: insert hyphen after “DAC” (DAC-controlled).
- p. 358 par. 3, line 3: insert “*et*” in (Richter *al.* 1996)
- p. 360 par. 2, line 5 : ... before and after trimming ... (insert after)
- p. 360 par. 3, line 5: ... are incorporated in ... (replace “provide on”)
- p. 360 par. 5, line 2: Gray instead of Grey
- p. 361 par. 2, line 3: insert comma after tolerance  
 par. 2, line 6: limit instead of limits
- p. 363 1<sup>st</sup> paragraph, last sentence:  $X_0$  instead of  $X_1$
- p. 363 par. 4, line 4: electro–mechanical (dash instead of hyphen)
- p. 365 line following eqn 8.24; However, the ... (instead of The)
- p. 368 par. 3, line 1: gamma-ray (insert hyphen)
- p. 370 line 17: Small systems (plural)
- p. 373 in enumerated list add commas at end of items 1 – 6
- p. 375 Section 8.10.3, line 2: ... the practitioner’s “I switched it on and it works”  
 (insert “the practitioner’s”)
- p. 376 par. 4, line 4: The rate of microdischarges typically decays ...  
 (insert “typically”)

- p. 380 Reference Choong: spillover right margin
- p. 384 insert reference:  
Spieler, H. (1994). Analog front-end electronics for the SDC Silicon Tracker, *Nucl. Instr. and Meth.* **A342** (1994) 205 – 213
- p. 386 last sentence of paragraph 1: discusses some common problems (instead of “discusses on common problems”)
- p. 386 Section 9.1, line 5: replace period after  $Z_0 = \sqrt{L/C}$  by a comma.
- p. 389 par. 2, 3<sup>rd</sup> to last line: remove period after low noise.
- p. 392 par. 2, line 1: An alternative is to inspect the output ... (insert the)
- p. 394 par. 2, line 2: fasteners instead fasteners
- p. 394 par. 2, line 3: All signal input and output cables ... (insert cables)
- p. 394 Section 9.3.2, line 3: Nor are all parts of the circuit equally sensitive, ... (delete “are” following “circuit”)
- p. 395 Fig. 9.9 caption: ... conductor that “pins” the field lines (instead of “pin”)
- p. 395 Fig. 9.10 caption: coupling instead of soupling
- p. 403 line 2: correct leading quote preceding low
- p. 403 Fig. 9.19 caption: Current distribution (left) and ... (instead of “right”)
- p. 403 Subtitle 9.4.3: ground instead of gound
- p. 404 Fig. 9.20 caption: add “The configuration in the second panel avoids this problem.”
- p. 406 par. 1, line 4: feedthroughs instead of feed-throughs
- p. 407 Fig. 9.25 caption: receivers (plural)
- p. 412 Section 9.5.6, line 2: ... description in Chapter 6, the cascode ... (insert “in” and lower case “the”)
- p. 414 3<sup>rd</sup> paragraph, line 3: Insert comma after “For example”  
3<sup>rd</sup> paragraph, lines 2 & 3: footprint 1.6 x 0.8 mm<sup>2</sup> (add <sup>2</sup>)

- 5<sup>th</sup> paragraph, line 2: coefficient of ... (insert “of”)
- p. 415 Fig. 9.34 caption: ... surface mount capacitors ... (insert “surface”)  
line 3: The second panel compares ... (insert “panel”)  
line 4: ... and the third curve is for ... (insert “curve”)
- p. 415 lines 2 & 3: ... with a 10  $\mu$ F Y5V device. (instead of “with a Y5V device with 10  $\mu$ F”)
- p. 418 Section A.1., line 10: self-supporting (insert hyphen)  
line 14: small space in 100 mm
- p. 420 par. 1, line 7: is also used ... (replace “are”)
- p. 422 \index{phosphosilicate glass} instead of \index{phospho-silicate glass}
- p. 425 \index{water, deionized} instead of dionized.
- p. 426 par. 2, 2<sup>nd</sup> to last line: contours instead of countours
- p. 429 line 5: (see Wolf 2002) (insert “see”)
- p. 429 2<sup>nd</sup> to last line: ameliorated instead ameloriated.
- p. 430 ref. Fair (1981): italicize book title
- p. 433 last line: A phase shift of +90 appears ... (insert deg. symbol)
- p. 435 eqns C.3, C.4, and C.5: Change  $I(R_1)$  and  $I(R_2)$  to  $I_{R_1}$  and  $I_{R_2}$   
(as in eqn C.6)
- p. 437 line 8 after eqn C.11: circuit instead of citcuit.
- p. 438 Fig. D.1:  $-A_v$  in amplifier symbol
- p. 439 eqn D.6: reverse sequence of  $A_v A_{fb}$  to  $A_{fb} A_v$
- p. 439 Section D.2, line 1: For a small deviation ... (add “small”)
- p. 439 Section D.3, line 1: ... frequency-dependent ... (insert hyphen)
- p. 439 Section D3: replace  $f_c$  by  $f_u$

- Section D.3, line 2: replace “corner” by “upper cutoff”  
insert “is” after  $f_u$
- p. 440 eqn D.14: replace  $f_{cf}$  by  $f_{uf}$
- p. 440 sentence before D.4: By a similar calculation, a lower cutoff frequency is reduced ... (instead of corner frequency)
- p. 441 Subsection D.5.2, line 1: Again consider an inverting amplifier ...  
(insert “inverting”)
- p. 441 eqn D.20:  $v_o = -A_v v_i$   
eqn D.21:  $i_i = \frac{v_i(1 + A_v)}{Z_f}$   
eqn D.22:  $Z_{if} = \frac{Z_f}{1 + A_v}$   
eqn D.23:  $Z_{if} \approx \frac{Z_f}{A_v}$
- p. 441 line following eqn D.23: change to “Shunt negative feedback reduces ...”
- p. 443 change line following eqn D.29 to: ... the output resistance of the transistor  $r_o = dV_{CE} / dI_C$ , the change in output voltage
- p. 443 line preceding eqn D.30: ... the output resistance with feedback becomes (add “becomes”)
- p. 444 Fig. D.6: change  $A_v$  to  $A_v$
- p. 447 line 1: Before entering into ... (insert “into”)  
  
add at end of first paragraph: Furthermore,  $E_i$  denotes the intrinsic energy level, instead of the ionization energy.
- p. 447 last line, par. 2: occupancies instead ocupancies
- p. 448 add colon after first sentence. Remove period following eqn E.2
- p. 449 Sentence preceding eqn E.7: replace number by concentration  
  
eqns E.7 and E.8: replace  $n_e$  by  $n$ .
- p. 449 line preceding eqn E.10: place comma at end.

- p. 450      Section E.2, line 1: replace  $n_e = n_h$  by  $n = p$ .
- p.456      3<sup>rd</sup> line after eqn E.52: increases instead of indreases.
- p. 456      last par.: replace period by colon preceding enumeration
- p. 459      first sentence: delete “to avoid confusion ...” and add “and  $E_i$  is the intrinsic Fermi level”
- p. 460      last line, 2<sup>nd</sup> paragraph: quantitatively instead of quantitively.
- p. 461      line preceding F.13: replace “term” by “factor”.
- p. 464      par. 2, end of line 4: ... an excess of (replace “a”)
- p. 468      add at end of par. 2: Indirect bandgap materials show reduced transition probabilities, as the mismatch in  $k$ -space must be bridged.
- end of par. 3: ... although for some applications acceptable in thin ...  
             (insert “for some application” and replace following “for” by “in”)
- p. 470      line two after eqn F.49: insert comma after Chapter 7
- line five after eqn F.49: delete “)”.
- p. 472      Sentence at end of enumeration: The goal is to maximize 2(a) and 3(a).  
(add “2(a)”)